

## **CLAIMS**

What is claimed is:

1. A method for annealing a layer of material having a high dielectric constant (high-k) formed over a semiconductor substrate, comprising:

introducing an ambient comprising hydrogen, nitrogen and an oxidizer to the substrate and layer of high-k material; and

5 heating the high-k dielectric layer to a temperature greater than 700 degrees Celsius while the gate dielectric layer is in the ambient, the ambient mitigating the formation of lower dielectric constant (lower-k) material between the high-k gate dielectric layer and the substrate.

10 2. The method of claim 1, wherein the ambient comprises ammonia (NH<sub>3</sub>) and the oxidizer.

3. The method of claim 2, wherein the oxidizer includes at least one of O, N<sub>2</sub>O, NO and H<sub>2</sub>O.

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4. The method of claim 2, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of about 200 Torr.

20 5. The method of claim 2, further comprising heating the high-k dielectric layer to between about 700 to 1300 degrees Celsius.

6. The method of claim 2, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of  
25 about 20 Torr.

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7. The method of claim 2, wherein the ammonia is initially introduced to the high-k material followed by the oxidizer to mitigate the likelihood of crystallization of the high-k material.

5 8. The method of claim 2, wherein a greater concentration of the oxidizer is included in the ambient when nitrogen is pre-existing within the high-k material.

9. The method of claim 2, further comprising:  
10 adding argon to the ambient to broaden an acceptable temperature range.

10. A method for annealing a high dielectric constant (high-k) gate dielectric layer, comprising:

placing a wafer including one or more partially formed transistors in an  
15 ambient comprising hydrogen, nitrogen and an oxidizer, respective transistors comprising a high-k gate dielectric layer formed over a substrate; and

heating the high-k gate dielectric layer to a temperature greater than 700  
degrees Celsius while the gate dielectric layer is in the ambient, the ambient  
mitigating the formation of lower dielectric constant (lower-k) material between  
20 the high-k gate dielectric layer and the substrate.

11. The method of claim 10, wherein the ambient comprises ammonia (NH<sub>3</sub>) and the oxidizer.

25 12. The method of claim 11, wherein the oxidizer includes at least one of O, N<sub>2</sub>O, NO and H<sub>2</sub>O.

13. The method of claim 11, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of  
about 200 Torr.

5 14. The method of claim 11, further comprising heating the high-k  
dielectric layer to between about 700 to 1300 degrees Celsius.

15 15. The method of claim 11, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of  
10 about 20 Torr.

16. A method for fabricating a transistor having a high dielectric  
constant (high-k) gate dielectric layer, comprising:  
forming a high-k gate dielectric layer on a substrate; and  
15 annealing the substrate and high-k gate dielectric layer,  
the annealing comprising:  
introducing an ambient comprising hydrogen, nitrogen and an  
oxidizer to the substrate and high-k gate dielectric layer;  
heating the high-k dielectric layer to a temperature greater than 700  
20 degrees Celsius while the gate dielectric layer is in the ambient, the ambient  
mitigating the formation of lower dielectric constant (lower-k) material between  
the high-k gate dielectric layer and the substrate.

25 17. The method of claim 16, wherein the ambient comprises ammonia  
(NH<sub>3</sub>) and the oxidizer.

18. The method of claim 17, wherein the oxidizer includes at least one  
of O, N<sub>2</sub>O, NO and H<sub>2</sub>O.

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19. The method of claim 17, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of  
about 200 Torr.

5 20. The method of claim 17, further comprising heating the high-k  
dielectric layer to between about 700 to 1300 degrees Celsius.

21. The method of claim 17, further comprising:  
maintaining the high-k dielectric layer and ambient under a pressure of  
10 about 20 Torr.